AN ECOLOGICAL EFFECT OF THE NEW ENGLAND HURRICANE

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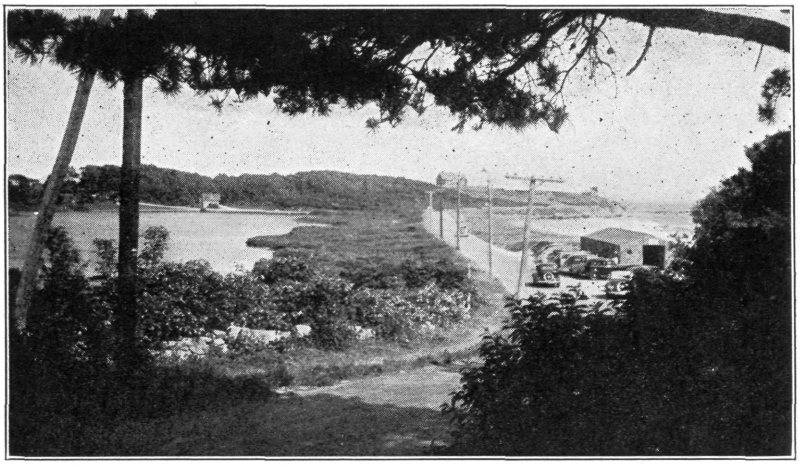
On September 21, 1938, a hurricane and an unusually high tidewater struck the general region of Woods Hole, Mass.[1] In addition to destruction of life and property, disruption of transportation and communication, etc., there was a distinct effect on the ecology of the region. Frequently during the summer of 1939 there was brought to the attention of the



Text Fig. 1. View looking toward the Nobska Light House (center) at Woods Hole, Mass. A road and a few yards of shore separate the Fresh Water Pond (on the left) from the sea (at right). The bathhouse shown at the extreme right next to the cars was washed into the Fresh Water Pond across the road during the hurricane.

students at the Marine Biological Laboratory the fact that the collecting sites showed some changes regarding the quantity and kinds of organisms available, as compared with collections made during the summers of previous years, before the hurricane. Moreover, some of the fresh-water ponds which were in the low lands near the seacoast became salty or brackish because they were flooded with sea water during the hurricane.

[1]Scientific Monthly, Jan. 1939, pp. 42–50.

The present article deals with such a pond which temporarily at least is brackish. It is known as the Fresh Water Pond and is located in Woods Hole just northwest of the Nobska Light House. This pond is on low terrain only a few yards away from the sea (Text fig. 1). Its bottom is somewhat variable, being of a sandy, rocky and muddy nature, depending upon the part of the pond examined.

Collections of specimens, particularly of Bryozoa or moss animals, were made in the pond several times during the summers of 1938 and 1939. During the summer of 1938, before the hurricane, fresh-water Bryozoa *Fredericella sultana* and *Plumatella* sp. were found growing quite abundantly on the lower surfaces of submerged rocks. When collecting during the summer of 1939, i. e., after the hurricane, the writer was struck with the fact that all fresh-water Bryozoan colonies found on the rocks were the previous year's growth and dead. Diligent search failed to disclose a single living colony of *Fredericella* or *Plumatella*. However, growing directly beside some of these killed but still attached fresh-water specimens were found living barnacles and live, thriving colonies of a salt or brackish water Bryozoan *Membranipora lacroixii*.

The outer chitinous covering or ectocyst of the *Fredericella* and *Plumatella* colonies which remained after the softer parts of the animals had disintegrated was quite sturdy and well cemented to the substratum (Plate I, fig. 5). It was in a good state of preservation. The seed-like reproductive bodies called statoblasts which characterize most of the fresh-water Bryozoa were firmly attached either to rocks or inside the zooecial tubes. A large percentage of the statoblasts were normal in shape or size but several somewhat atypical ones were found and are here figured (Figs. 2, 3, 4). That there is considerable variation in statoblasts is well known to all who have had the pleasure of working with this group.

The salt water species found in the pond the summer after the hurricane was somewhat difficult to name because its synonymy is in a considerable state of confusion. However, Dr. R. C. Osburn in 1910 reported the occurrence of *Membranipora lacroixii* from Buzzards Bay. Since the present pond specimens seem identical with his *M. lacroixii* figures (1910, U. S. Bur. Fish., Bull. XXX, Pl. 22, fig. 28) his terminology is being followed. This Bryozoan forms a delicate white calcareous meshwork or tracery on rocks. The extent of the colony is

varied, depending partly upon age. The largest colony observed was approximately 7 centimeters in diameter. It was collected on September 3, 1939. One rather unusual feature about this colony was that it was growing over fragments of the previous year's *Fredericella* and *Plumatella* colonies which were still attached to the rock.

The smoothness of the substratum on which the colony grows influences to some extent the shape of the zooecia or "cases" in which the individuals are housed. Zooecia growing on a fairly smooth or flattened surface are shaped like those pictured in Figure 9, being quite regular and longer than wide, while those growing over crevices or irregularities may be irregular, pyriform or long and very narrow. The following zooecial and opesial measurements were made on 14 regular zooecia, while the operculum measurements were made on only 4 specimens.

TABLE I

	Maximum in mm.	Minimum in mm.	Average in mm.
Zooecial length	0.52	0.42	0.476
" width	.31	.26	.291
Opesial length	.46	.34	.413
" width	.26	.20	.226
Operculum length	.11	.10	.103
" width	.13	.09	.111

Ovicells and avicularia are lacking. The oral arch is slightly raised and is higher than the rest of the zooecium. Opesia large and elliptical bordered by a narrow, raised, granulate or finely tuberculate rim, some of the delicate processes of which project into the opesia. Several multiporous rosette plates, generally 3 but occasionally as many as 6, may be found in the lateral wall (Figs. 6, 8). The operculum is slightly wider than long, with a chitinous rim reinforcing its edge. The rim is about 15 to 25 micra wide. The operculum is not calcified.

It would be an interesting problem to watch the pond for the reappearance of the fresh-water forms *Fredericella* and *Plumatella* and for the disappearance of the brackish *Membraniporan* species and for succession of organisms over a period of several years.

EXPLANATION OF PLATE I

Figs. 1, 2, 3 and 4. Variously shaped statoblasts (reproductive bodies) of the fresh-water form *Fredericella sultana*. The last three are quite atypical.

Fig. 5. A fragment of a 1938 *Fredericella* colony (dead) collected in late summer of 1939 and showing several empty zooecial tubes (*Z*).

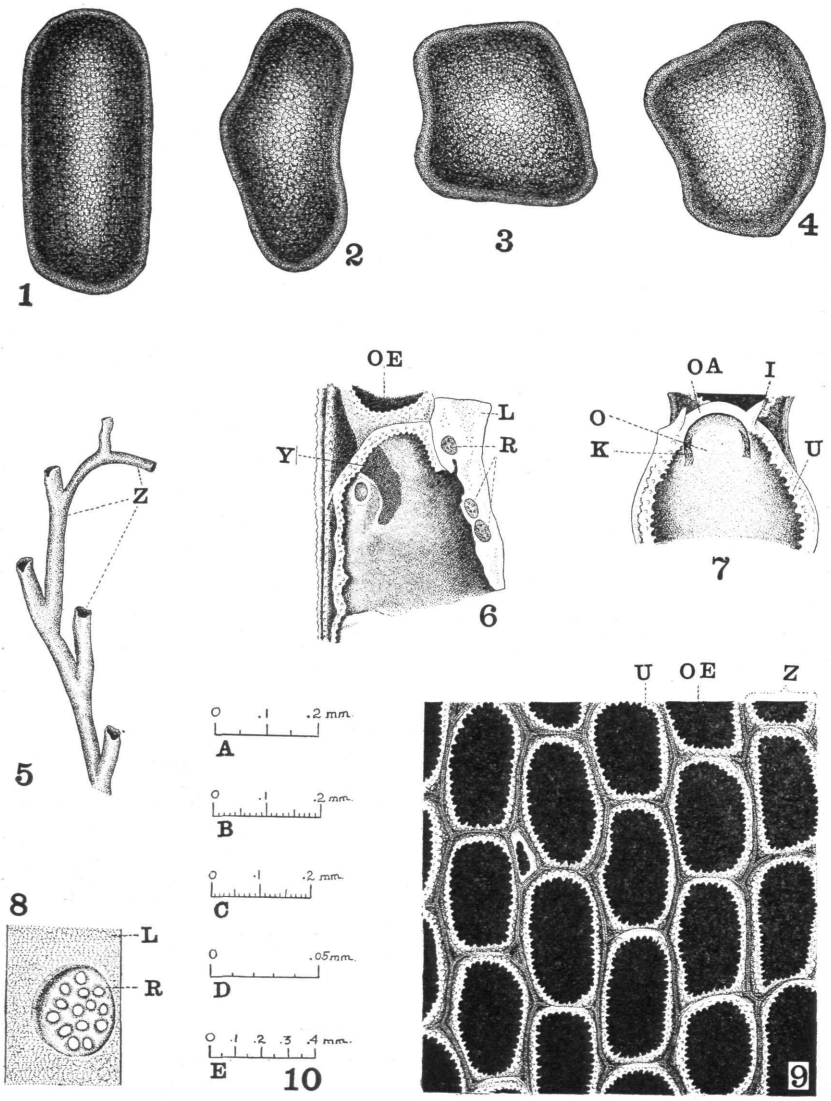
Fig. 6. Fragment of 2 zooecia of *Membranipora lacroixii* (brackish or salt water form) showing 4 rosette-plates (*R*) in the lateral walls (*L*) and a thinner section (*Y*) of the dorsal wall which was observed more clearly on one specimen than on any others. *OE* refers to the large opening or opesium. Part of the lateral wall and opesial border are torn away in this specimen.

Fig. 7. Part of a zooecium of *M. lacroixii* showing the operculum (*O*) which has a distinct chitinous border (*K*). The zooecium is slightly different in shape from those in Fig. 9, but is not at all unusual. Individuals with 2 spine-like processes (*I*) near the oral arch (*OA*) were very rare, occurring only in a few zooecia of a young colony. Some of these processes were jagged and less like hooks than in present figure. *U* refers to the delicate processes projecting into the opesium from the calcareous wall.

Fig. 8. Section of a lateral wall (*L*) of *M. lacroixii* showing a rosette-plate or pore-plate in greater detail than in Fig. 6.

Fig. 9. Section of a colony of *M. lacroixii* showing a number of ordinary zooecia (*Z*) and a rudimentary one. The opercula and membranes covering the zooecial openings have been burned off to show the zooecial outlines more clearly. Abbreviations same as for preceding figures.

Fig. 10. All the preceding figures were drawn with the aid of a camera lucida. The scales for the various figures are here given: Scale *A* for Figs. 1 to 4, *B* for Fig. 6, *C* for Fig. 7, *D* for Fig. 8 and *E* for Fig. 9.


1
2
3
4
OE
L
R
Y
6
OA
I
O
K
U
7
Z
5
U
OE
Z
0 .1 .2 mm.
A
0 .1 .2 mm.
B
0 .1 .2 mm.
C
0 .05mm.
D
0 .1 .2 .3 .4 mm.
E
10
8
L
R
9